

Bifunctional Regenerative Electrochemical Air Transformation for Human Environments, Phase I

Completed Technology Project (2018 - 2019)



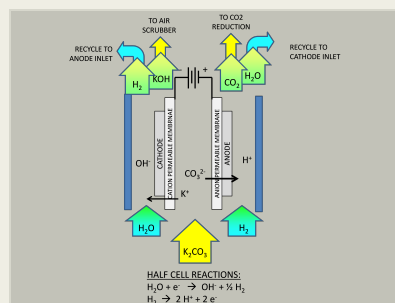
Project Introduction

The proposed Bifunctional Regenerative Electrochemical Air Transformation for Human Environments (BREATHE) for life support and habitation is part of the atmosphere revitalization equipment necessary to provide and maintain a livable environment within the pressurized cabin of crewed spacecraft. Sustainable Innovations (SI) has developed a novel solid state technology for gas compression based on its proven hydrogen concentration, generation and compression technology that we are currently developing for NASA applications. The technology is solid state with no moving parts, silent, electrically and thermally efficient, and scalable and capable of high pressure – routinely as high as 4,500 psi and demonstrated to 12,500 psi. The Phase 1 objective is to develop a proof of concept device and demonstrate the feasibility of the technical approach for a solid state electrochemical CO₂ compressor that will also be suitable for other logistically important gases: CO₂, O₂ and H₂. SI will develop high pressure BREATHE system architecture, focusing on integrating components and making the electrochemical stack lightweight. In addition to decreasing weight, volume and cost, this will increase reliability and durability.

Anticipated Benefits

The BREATHE system is designed to provide critical life support on-board spacecraft during long flight time missions. In this application the system would be sourcing CO₂ from crew exhalation, and compressing it for supply to electrochemical reduction systems for converting this resource to logistic fuels with oxygen as a byproduct for human life support. This is a critical function for closed environment life support wherein carbon dioxide management can be a limiting factor.

Advancement of SI High Pressure Electrochemical Technologies - We anticipate that the results of the high pressure architecture technology development effort for this project will be fed to Sustainable Innovations pipeline of products which also includes the H₂RENEW™, a system that separates and compresses hydrogen for industrial applications and the CO₂RENEW™, a system that converts waste CO₂ to useful fuels and commodity chemicals.



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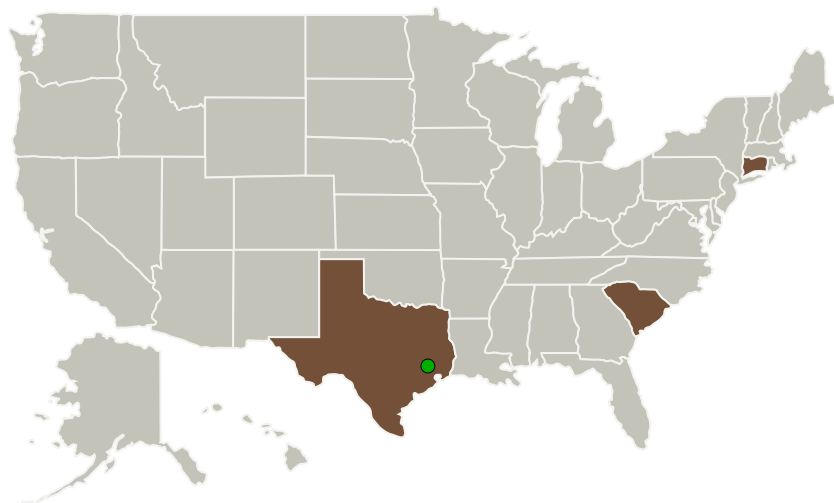
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Skyre Inc	Lead Organization	Industry Small Disadvantaged Business (SDB)	
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
University of South Carolina-Columbia	Supporting Organization	Academia	Columbia, South Carolina

Primary U.S. Work Locations	
Connecticut	South Carolina
Texas	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Skyre Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

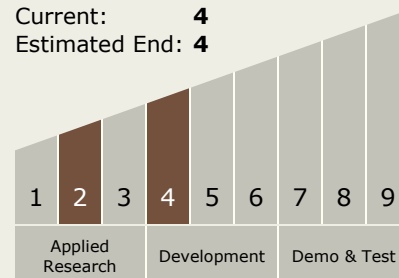
Carlos Torrez

Principal Investigator:

Trent Molter

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4



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Project Transitions

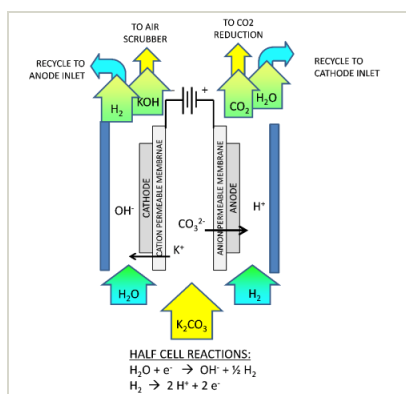
July 2018: Project Start

August 2019: Closed out

Closeout Documentation:

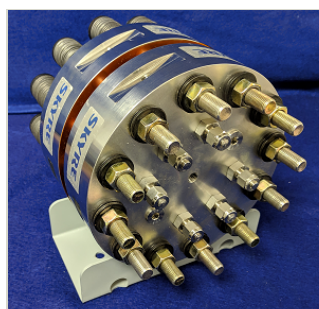
- Final Summary Chart(<https://techport.nasa.gov/file/141289>)

Images



Briefing Chart Image

Bifunctional Regenerative Electrochemical Air Transformation for Human Environments, Phase I (<https://techport.nasa.gov/image/133479>)



Final Summary Chart Image

Bifunctional Regenerative Electrochemical Air Transformation for Human Environments, Phase I (<https://techport.nasa.gov/image/127976>)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
 - TX06.1.1 Atmosphere Revitalization

Target Destinations

The Moon, Mars, Earth